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<p>(21) International Application Number: PCT/FI98/00030</p> <p>(22) International Filing Date: 15 January 1998 (15.01.98)</p> <p>(30) Priority Data: 970278 23 January 1997 (23.01.97) FI</p> <p>(71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): PENTIKÄINEN, Heimo [FI/FI]; Kurjenpolvi 1 J 7, FIN-90580 Oulu (FI). PAANANEN, Kirsi [FI/FI]; Viklatie 12 D 17, FIN-90540 Oulu (FI). SIMONEN, Kirsi-Marjut [FI/FI]; Kalevalantie 15 A 310, FIN-90570 Oulu (FI). SUUTARI, Jyrki [FI/FI]; Laurinkuja 2 B 10, FIN-90420 Oulu (FI).</p> <p>(74) Agent: PAPULA REIN LAHTELA OY; Fredrikinkatu 61 A, P.O. Box 981, FIN-00101 Helsinki (FI).</p>		
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<p>(54) Title: PROCEDURE FOR CARRYING OUT CHECKING FUNCTIONS RELATING TO SAFETY MANAGEMENT IN A MOBILE COMMUNICATION NETWORK AND/OR IN A WIRELESS LOCAL NETWORK</p>		
<p>(57) Abstract</p> <p>The invention relates to a procedure for carrying out checking functions relating to safety management in a mobile communication network and/or in a wireless local network during call setup. In the procedure, information about the degree of occupancy of a data processing apparatus implementing the checking functions in a network element, such as a mobile communication switching centre and/or the access node of a wireless local network, is continuously determined, the frequency of execution of the checking functions is adjusted based on the occupancy information thus determined, and checking functions are carried out on the calls according to the checking frequency defined for the respective degree of occupancy.</p>		
<pre> sequenceDiagram     participant WLL     participant BTS     participant AN     participant LE      Note over WLL, BTS: Radio access part on CCCC     WLL-&gt;&gt;BTS: 1 channel request     BTS-&gt;&gt;AN: 2 channel required     AN-&gt;&gt;BTS: 3 channel activation     BTS-&gt;&gt;LE: 4 channel activation ack     LE-&gt;&gt;AN: 5 immediate assignment command     AN-&gt;&gt;BTS: 6 immediate assignment     Note over AN: DDCH establishment part     AN-&gt;&gt;BTS: 7 sabm (cm serv_req)     BTS-&gt;&gt;LE: 8 establish indication     Note over LE: TCH signalling part     Note over AN: Register functions started at AN     AN-&gt;&gt;BTS: 10 identification_request     BTS-&gt;&gt;AN: 11 identification_response     Note over AN: Decision about carrying out identification (messages 12 and 13)     AN-&gt;&gt;BTS: 12 authentication_request     BTS-&gt;&gt;AN: 13 authentication_response     Note over AN: encryption signal etc.     Note over AN: Decision about carrying out equipment identity check     </pre>		

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PROCEDURE FOR CARRYING OUT CHECKING FUNCTIONS RELATING  
TO SAFETY MANAGEMENT IN A MOBILE COMMUNICATION NETWORK  
AND/OR IN A WIRELESS LOCAL NETWORK

The present invention relates to a procedure  
5 for carrying out checking functions related to safety  
management during call setup in a mobile communication  
network or in a wireless local network.

During call setup in a mobile communication  
network and/or in a wireless local network, various  
10 checking functions relating to network safety manage-  
ment are carried out. These checking functions are de-  
signed to prevent unauthorised network access for  
users not entitled to use the network, and to prevent  
the use of e.g. a mobile station that has been repor-  
15 ted lost. Such checking functions are performed during  
call setup normally by means of a data processing ap-  
paratus used for operation control, located in a mobi-  
le communication switching centre and/or in the access  
node of a wireless local network. The problem is that  
20 such checking functions take up call setup time. The  
heavier the load on the data processing apparatus, the  
more the call setup is retarded. Slow call setup again  
is unpleasant for the user. Especially in the case of  
a wireless local network (WLL), fast setup of outgoing  
25 calls is important.

The object of the present invention is to  
eliminate the drawbacks described above.

A specific object of the invention is to pre-  
sent a procedure that enables the call setup speed to  
30 be kept within reasonable limits in conditions of a  
high level of occupancy, yet without substantially im-  
pairing network safety.

The procedure of the invention is characte-  
rised by the features presented in claim 1.

35 In the procedure of the invention, informati-  
on about the occupancy of a data processing apparatus

implementing checking functions in a network element, such as a mobile communication switching centre and/or the access node of a wireless local network, is continuously determined, the frequency of execution of the checking functions is adjusted based on the occupancy information thus determined, and checking functions are carried out on calls according to the checking frequency defined for the respective degree of occupancy.

10       The invention has the advantage that the procedure allows a workable and self-adjusting compromise between call setup speed and safety. In spite of a high degree of occupancy of the data processing apparatus performing checking functions, the call setup  
15 time will not substantially exceed the normal setup time because some calls are passed through without a safety check. However, safety is not substantially impaired as it is very unlikely for the next calls from the same user's mobile station to be passed through  
20 unchecked, because the degree of occupancy determining the checking frequency varies continuously.

In an embodiment of the invention, when the degree of occupancy is lower than a predetermined limit, the checking functions are carried out at a specified high checking frequency. In conditions of low  
25 occupancy, every call, or 100% of the calls, could be checked.

In an embodiment of the procedure, when the degree of occupancy is higher than a predetermined limit, the checking functions are carried out at a specified low checking frequency. In conditions of high  
30 occupancy, a definition can be made to the effect that e.g. only 5% of the calls are checked.

In an embodiment of the procedure, the limits  
35 are parameters that can be changed by the network operator.

In an embodiment of the procedure, the checking function for which the checking frequency is adjusted is authentication or the checking of the right of access, wherein the subscriber data for the mobile station are verified during call setup and possible illicit network access is denied.

In an embodiment of the procedure, the checking function for which the checking frequency is adjusted is an equipment identity check, wherein the equipment identity code sent by the mobile station is checked during call setup by comparing it with a register of equipment identity codes for mobile stations reported stolen and/or defective.

In an embodiment of the procedure, the equipment identity check is verification of the IMEI code. IMEI is an international mobile station equipment identity code, which enables the mobile station to be unambiguously identified. E.g. in the GSM system, the IMEI code is a 15-digit number and it is divided into a 6-digit type approval code (TAC), a 2-digit assembly code (FAC) identifying the assembling factory, a 6-digit serial number and a 1-digit reserve number.

In an embodiment of the procedure, the mobile communication network is a GSM/DCS mobile communication network. GSM is a European digital mobile communication system (GSM, Global System for Mobile Communications). DCS (Digital Cellular System) is a mobile communication system standardized by the ETSI and based on the GSM specification, aimed at a more effective use of microcells; e.g. DCS-1800 works in a frequency range of 1800 MHz.

In an embodiment of the procedure, the wireless local network is a so-called WLL (Wireless Local Loop) network. In a WLL network, the subscriber's station is connected via a radio link to an access node or WLL controller. The WLL system may be based e.g. on technology used in a mobile communication system, such

as the GSM/DCS-1800 technology. Between the subscriber's station and the access node there is a base transceiver station, through which call signals sent by the terminal device over a radio channel are transmitted via the access node to a public telephone network and vice versa. The access node or WLL controller can be connected to the telephone exchange using e.g. the V5.1 or V5.2 protocol consistent with the ETSI standards.

10 In an embodiment of the procedure, identity data left unchecked because of high occupancy are stored for possible later checking.

In the following, the invention will be described in detail by the aid of an embodiment example by referring to the attached drawing, which presents a call setup signalling diagram according to an embodiment of the procedure of the invention in a case where a subscriber's station in a wireless local network originates a call.

20 The signalling diagram in the figure represents a call originated by a subscriber's station in a wireless local network WLL, substantially corresponding to a mobile originated call MOC consistent with the GSM specifications. The system components in the diagram are a base transceiver station BTS, an access node AN and a local exchange LE.

The access node AN contains three program blocks called registers. These are an equipment register, an authentication register and, placed hierarchically above these, a main register. The equipment register contains the equipment numbers (IMEI). The equipment number may be placed on a white, grey or black list, and in an equipment identity check the equipment register returns the IMEI list colour. The authentication register produces the triplets needed for identification and contains the information required for identification. The functions of the main

register include deciding about the execution of checking functions.

In the GSM/DCS world, the following register terms are used: authentication register AUC; AC  
5 (authentication centre), equipment register EIR (equipment identity register) and main register VLR (visitor location register). In wireless local loop environment, the main register block is termed WFR (wireless fixed register).

10 The call setup procedure in a wireless local network in a so-called non-transparent mode as presented in the figure is substantially similar to call setup in a normal GSM system. In a wireless local network system, the access node AN also comprises func-  
15 tions that are included in the mobile services switching centre/visitor location register MSC/VLR and home location register/authentication centre/equipment identity register of a normal GSM system. The subscriber's stations in a wireless local loop WLL commu-  
20 nicate with the access node AN over a radio link. The signalling between the subscriber's station WLL and the access node AN consists of message-based signalling consistent with the GSM specifications (GSM/DCS). The access node AN again is connected to a wired net-  
25 work local exchange LE via an V5.2 interface consistent with the ETS 300 347-1 standard.

When a subscriber lifts the receiver, the subscriber's station generates a local dialling tone. The subscriber has a predetermined length of time to  
30 dial the first digit. The dialling tone goes off as soon as the first digit has been dialled. Call setup is started upon the lapse of a predetermined period of time after the last digit has been dialled. The subscriber's station WLL requests a call by sending a  
35 CHANNEL REQUEST message to the base transceiver station BTS. The base transceiver station BTS transmits the channel request to the access node AN, which

starts searching for a communication channel. After a communication channel has been successfully reserved, the access node activates the channel by sending a CHANNEL ACTIVATION message to the base transceiver station BTS. The base transceiver station BTS acknowledges successful activation by returning a CHANNEL ACTIVATION ACK message. The base transceiver station BTS starts transmission and reception over this channel using the capacity and timing data received in the CHANNEL ACTIVATION message. After successful activation of the communication channel, the access node AN transmits an IMMEDIATE ASSIGNMENT COMMAND message to the base transceiver station BTS. This message contains an IMMEDIATE ASSIGNMENT message, which is sent by the base transceiver station BTS to the subscriber's station WLL. Upon receiving the IMMEDIATE ASSIGNMENT message, the subscriber's station WLL is tuned to the communication channel assigned and starts setting up a signalling link over the network. The subscriber's station WLL transmits a layer-2 SABM message to the base transceiver station BTS via the communication channel. SABM contains a layer-3 service request message. The base transceiver station transmits the service request of the subscriber's station further to the access node AN in an ESTABLISH INDICATION message, which includes a temporary mobile subscriber identity code TMSI. The base transceiver station BTS acknowledges the SABM message by sending a UA frame to the subscriber's station WLL. At this stage, the wireless fixed register program block WFR issues to the control program an inquiry about the occupancy of the computer unit and, based on this, decides whether authentication is to be carried out and somewhat later, after possible authentication, encrypting message etc., the wireless fixed register likewise decides whether an equipment identity check (IMEI check) is to be carried out or not. The rest of



the message exchange in the call setup procedure is done in accordance with the conventional scheme, which will not be described here in detail.

The checking functions can be implemented for example in such a way that if the degree of occupancy of the computer unit performing the checking functions is 30% or below, then the authentication and equipment identity checks are carried out for every call. If the computer unit's occupancy is 70% or above, no checking functions are performed at all. When the occupancy is between 30 - 70 %, the checking frequency could grow e.g. linearly from a frequency covering all calls to a frequency covering every twentieth call. The limits are preferably parameters subject to change by the operator. In addition, it is possible to use an arrangement in which the checking frequency and the equipment authentication frequency are somewhat different from each other so that these functions will not have to be performed on the same call when not all calls are checked.

The invention is not limited to the embodiment example presented above, but many variations are possible within the framework of the inventive idea defined by the claims.

## CLAIMS

1. Procedure for carrying out checking functions relating to safety management in a mobile communication network and/or in a wireless local network during call setup, characterized in that

information about the degree of occupancy of a data processing apparatus implementing the checking functions in a network element, such as a mobile communication switching centre and/or the access node of a wireless local network, is continuously determined,

the frequency of execution of the checking functions is adjusted based on the occupancy information thus determined, and

checking functions are carried out on the calls according to the checking frequency defined for the respective degree of occupancy.

2. Procedure as defined in claim 1, characterized in that, when the occupancy is below a predetermined limit, the checking functions are carried out at a predetermined high checking frequency.

3. Procedure as defined in claim 1 or 2, characterized in that, when the occupancy is above a predetermined limit, the checking functions are carried out at a predetermined low checking frequency.

4. Procedure as defined in claim 2 or 3, characterized in that the limits are parameters that can be changed by the network operator.

5. Procedure as defined in any one of claims 1 - 4, characterized in that the checking function for which the checking frequency is adjusted is authentication, or the checking of the right of access, wherein the subscriber data for the mobile station are verified during call setup and possible illicit network access is denied.

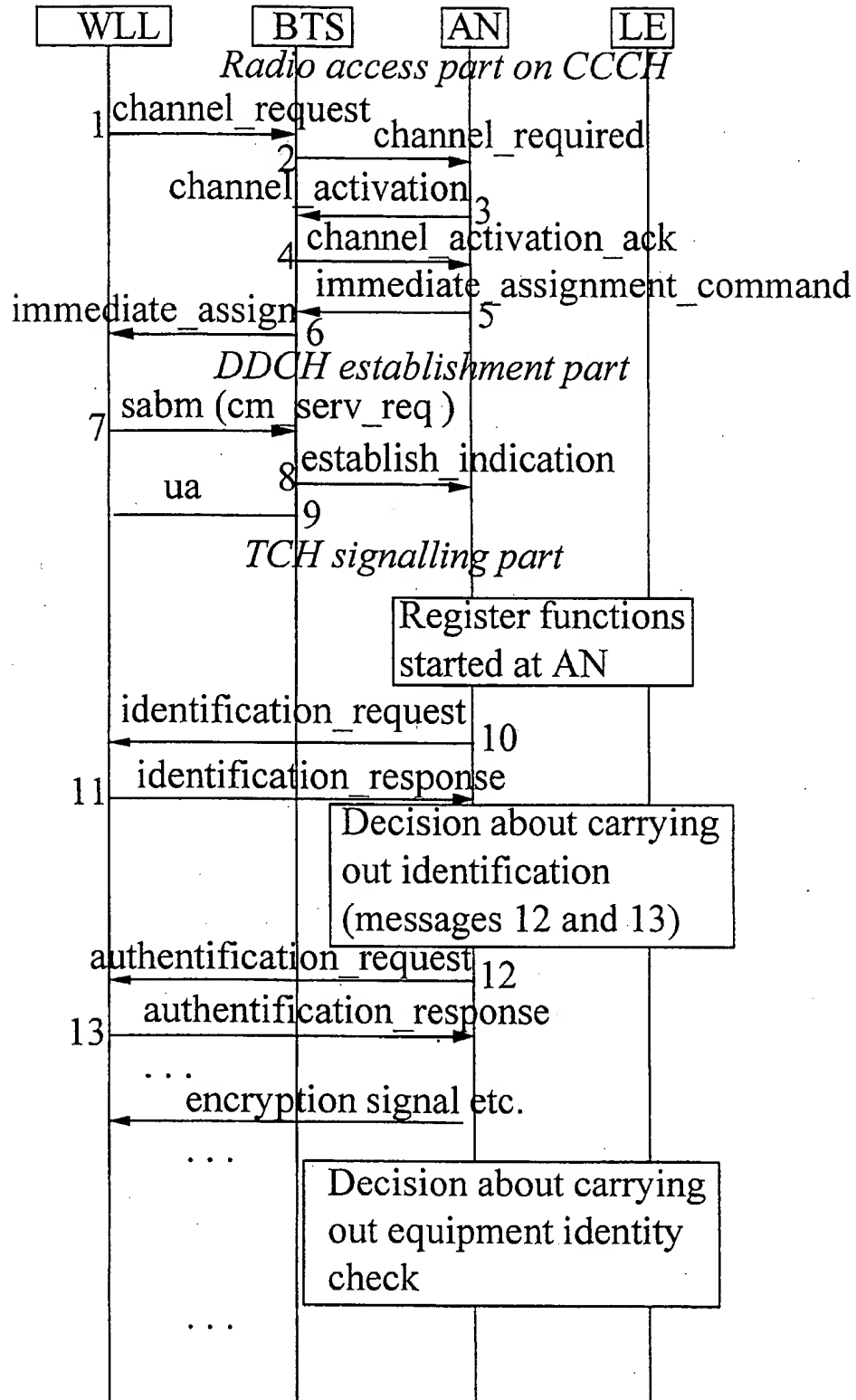
6. Procedure as defined in any one of claims 1 - 5, characterized in that the checking function for which the checking frequency is adjusted is an equipment identity check, wherein the equipment identity code sent by the mobile station is checked during call setup by comparing it with a register of equipment identity codes for mobile stations reported stolen and/or defective.

7. Procedure as defined in claim 7, characterized in that the equipment identity check is verification of the IMEI code.

8. Procedure as defined in any one of claims 1 - 7, characterized in that the wireless local network is a so-called WLL network (Wireless Local Loop).

10. Procedure as defined in any one of claims 1 - 9, characterized in that identity data left unchecked because of a high degree of occupancy are stored for possible later checking.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 98/00030

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0708573 A2 (TELIA AB), 24 April 1996 (24.04.96), see whole document  --	1
A	WO 9621327 A1 (ALCATEL STANDARD ELECTRICA S.A.), 11 July 1996 (11.07.96), page 3, line 6 - line 30, abstract  --	1,5,6,8,10

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>IEEE International symposium on personal, indoor and mobile radio communications. 5th (PIMRC'94) and ICCRC Regional meeting on wireless computer networks (WCN). Proceedings of wireless networks catching the mobile future. The Hague 18-23 Sept. 1994</p> <p>Quality of Speech Services in GSM-Definition of a Universal Quality Parameter for Quality Comparison and Evaluation</p> <p>Arie Verschoor, see whole document</p> <p style="text-align: center;">-- -----</p>	1,5,6

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

09/06/98

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**PCT/FI 98/00030**

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